

I reported the first successful removal of a hydatid from the pancreas.

At the present time, we attack the nonmalignant tumors of the pancreas with confidence. The acute infections are diagnosed without a wide margin of error, and surgical interference seems to have resulted in a distinct improvement in results.

The clinical diagnosis of the neoplasms of the pancreas leaves much to be desired. Localized infections and inflammatory cysts may so closely simulate malignancies that radical removal of pancreatic tissue at a time where a cure for malignant tumors is possible may lead us to radical removal of relatively harmless structure, with unnecessary danger to the patient.

Four personal cases, all apparently alike, will illustrate a tumor-like mass found in the head of the pancreas presented all of the clinical aspects of malignancy, with common-duct occlusion at the ampulla. Palliative surgery was performed in all of the cases, consisting of a cholecystoduodenostomy. There were three complete recoveries, proving that the condition was benign in three of four cases. The fourth case went on to rapid termination.

Where the diagnosis is certain, radical surgical attack is justified and gives hopes for otherwise terminal condition in malignancy of the pancreas. The essayist has shown that surgical interference in cases of hyperinsulinism is clearly indicated. The pancreas offers a relatively new and most interesting field for surgical endeavor.

SURGICAL TREATMENT OF STOMACH ULCER*

By CHARLES EATON PHILLIPS, M.D.
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DISCUSSION by Verne C. Hunt, M.D., Los Angeles;
Asa Weston Collins, M.D., San Francisco; George
Thomason, M.D., Los Angeles.

EFFORTS directed toward the relief or cure of any disease condition should be guided by a comprehensive idea of its cause, development, possible sequelae and the factors leading to its recovery. This is particularly true concerning the relief and cure of stomach ulcers.

The question of surgical intervention depends on the prognosis following medical management on one hand, and the expected benefits and dangers of attending operative interference on the other.

PATHOGENESIS

We know no specific cause for stomach ulcers. Like those developing in other parts of the body, there are probably a number of activating factors causing the condition. In order of their importance we may enumerate:

First: Undiluted gastric juice. This will almost certainly cause ulcers, as has been shown by the experiments of Mann,¹ Dragstedt,² Ochsner,³ and others. Undiluted gastric juice may result from functional, mechanical or mental disturbances interfering with the normal working of the stomach.

Second: Infections. About 50 per cent of stomach ulcers show the presence of infectious organisms. The presence of contact ulcers in a lesser number show the relative importance of infection as an etiologic factor.

Third: General physical impairment with lack of tissue resistance predispose to their formation.

Fourth: Mechanical irritation is a minor factor responsible for some.

Fifth: Heredity and external trauma are occasional factors.

Of these causes, the presence of undiluted gastric juice is the most important. Experiments have shown that not only does undiluted gastric juice cause ulcers, but the neutralization of the acid results in their prompt relief. Of equal importance, it has been shown that the normal sequence of the gastro-intestinal tract is essential to health and function. For example, the elimination of the neutralizing action of the duodenum (by sidetracking operation) will result in frequent ulceration when the stomach contents are passed directly into the jejunum. When the stomach contents are diverted into the ileum, ulcerations almost surely follow.

DIAGNOSIS

A fairly characteristic symptomology consisting of food pain, hematemesis, melena, abdominal pain, localized tenderness, nausea and vomiting, and finally the visualization by the x-ray, in suitable cases, establishes the diagnosis of ulcer.

TREATMENT

The treatment of stomach ulcers is a medical problem except in fairly well defined limits. In early adult life the treatment is medical until such time as there is a reasonable doubt that a cure can be effected; in other words, after there have been relapses following apparent cures, and this has been repeated with the patient exercising reasonable care in diet and habits of living. It is better to consider the case surgical rather than to risk perforation, hemorrhage or long invalidism and ultimate malignancy, by further medical treatment. In later life, lowered resistance and the increased risk of malignancy shorten the legitimate time for medical treatment. Any treatment other than that necessary for operative preparation may be contraindicated.

The size, location and physical characteristics of the ulcer, together with the age and general physical condition of the patient, determine the time and character of the operation. The size of the ulcer has little significance regarding its probable malignancy. Many large ones are benign and many small ones are malignant.

Indications for Surgical Relief.—Indications for surgical relief depend on (a) the patient, his age, family history of ulcer and cancer, his adaptability to follow a medical cure; the urgency and duration of the symptoms; and the size and location of the ulcer. (b) The doctor. Indications for operation vary with the ability of the operator. One surgeon may resect a stomach ulcer with ninety-eight chances in a hundred that the patient will recover, while another operator may be able to offer the patient only fifty to seventy-five chances of recovery in the same series. The patient would be a good risk in the hands of one, while the operation would be contraindicated in the hands of another.

Surgery for relief of gastric ulcer has undergone great changes in the past decade. The opera-

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tion of gastro-enterostomy has been followed too frequently by bleeding ulcers, cancerous degeneration in remaining ulcers, dumping stomachs and jejunal ulcers. The logical treatment of ulcer is that of resection of the ulcer-bearing area, and the restoration of the normal sequence of the gastro-intestinal tract. For obvious reasons, the preservation of the duodenum, with its essential buffer substances, is desirable. When extensive pathology requires that anastomosis be performed between the stomach and the jejunum, it is essential to remove a larger part of the secreting surface of the stomach to reduce the acid content of the gastric secretion.

The results following the radical removal of the distal half of the stomach more than justify the added difficulties of operation.

A comparative table of results of gastro-enterostomy and partial gastrectomy, by Richard Lewisohn,⁴ with a follow-up over a five-year period, show that about eighteen times as many jejunal ulcers follow gastro-enterostomies as occurred in the same number of resections. These were the results found by a subsequent operation. Ulcers of the stomach requiring surgery for their relief are entitled to resection when the patient's condition will permit. By resection we include the distal half of the stomach, where over 80 per cent of the ulcers are found. The removal of this portion of the stomach not only removes the majority of the ulcer-bearing area, but also such a part of the acid-secreting surface that further ulceration is rare.

Pyloroplasty furnishes a logical restoration of the gastro-intestinal tract, permitting the normal neutralizing of the gastric juice by the mixture of the duodenal secretions and at the same time preservation of the normal sequence of the gastro-intestinal tract.

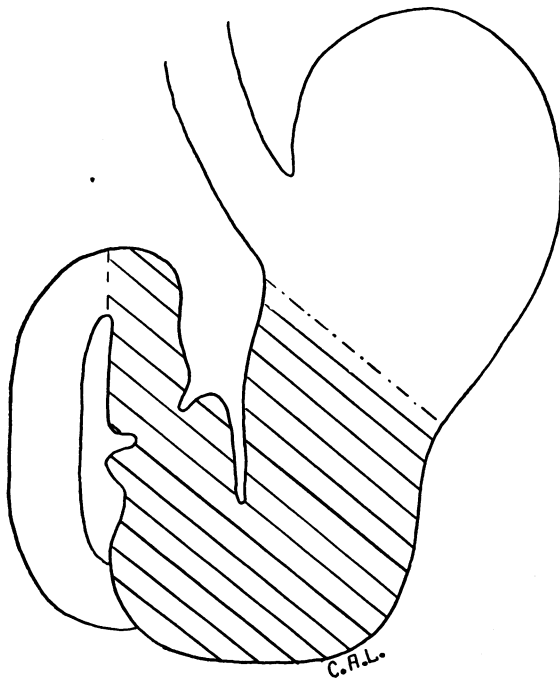


Fig. 1.—Contour of normal stomach, showing extent of gastric resection.

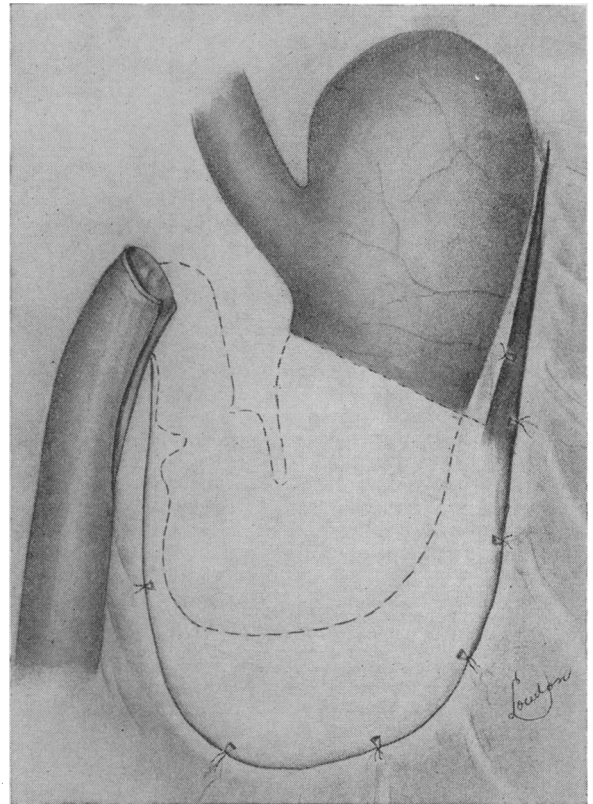


Fig. 2.—Extent of gastric resections with accommodating incisions.

Its disadvantages consist in difficulties of operative technique, but chiefly it does not remove the parts most liable to suffer subsequent pathologic changes. The development of ulcer surgery has been toward the wider removal of the ulcer-bearing area, and the attaching of the open end of the stomach to the side of the duodenum. The author's technique has been similar to that described by Horsley⁵ for the relief of cancer of the stomach.

PROCEDURE IN OPERATION

After preliminary preparation, a Levine tube is passed into the stomach through the nose before the anesthetic is started. Adequate exposure is afforded by a paramedian incision extending from the ensiform to the right of the umbilicus. The lesser peritoneum is explored by the finger through the gastrohepatic omentum. The extent of the pathology and the mobility of the stomach are determined. The gastrocolic omentum is opened, and Pahr clamps are applied across the stomach, which is severed between them by the cautery. The distal part of the stomach is turned to the right and the pylorus is freed to the first portion of the duodenum. A small Pahr clamp is placed just beyond the pylorus. The pyloric artery is tied. A crushing clamp is not applied to the duodenum, but the blood supply is controlled by the left thumb and finger until the bleeding points are picked up individually and tied. A clamp devitalizes the tissue to be approximated and may result in an insecure hemostasis.

The second portion of the duodenum is mobilized by incising the reflection of the peritoneum to the right. The duodenum is then rolled over on its mesentery, so that it approximates the stump of the stomach which is mobilized by incising the gastrocolic omentum. The anterior side of the duodenum is split down its long axis for about two inches, so that the open end and side of the duodenum will approximate the cut end of the stomach. The posterior side of the cut end of the stomach is fixed to the superior border of the duodenum, while the greater curvature of the stomach is fixed to the bottom of the incision made in the second portion of the duodenum. The serous and muscular coats of the stomach are attached to the corresponding layers of the duodenum by a continuous suture of chromic gut. The mucosa is then approximated by a running stitch of the gastro-intestinal suture, accurately approximating the mucosa of the stomach to that of the duodenum. The Levine tube, which was passed into the stomach before the anesthetic was started, is now adjusted in the stomach or passed into the duodenum if desired. The anterior row of sutures completes the anastomosis. This is further reinforced by another row of mattress sutures of silk or linen. The closure of the abdominal wall should be secure and adequate, as tissue repair may be slow in those suffering from malnutrition. Preference is for a forty-day chromic stitch for closure of the fascia.

With very extensive pathology the operation of a subtotal gastrectomy may be indicated. The so-called Polya method of closure may be the method of choice in effecting the restoration. The duodenum is closed by infolding and suturing to the pancreas. The anastomosis is completed by an end-to-side closure, the stomach to the jejunum. Theoretically as well as practically, it is desirable to resect much of the acid-secreting surface of the stomach before the anastomosis is completed with the jejunum. It is only by this mechanical lowering of the acidity of the stomach that the jejunum is able to stand the direct action of the gastric juice.

COMPLICATIONS

Hemorrhage.—Hemorrhage occurs in 8 per cent of stomach ulcers, and is responsible for a mortality of 16 to 29 per cent of those affected (Finney⁶). Hemorrhage becomes a surgical problem when a known localized ulcer continues to bleed after adequate medical treatment has been administered. It becomes a surgical problem while the patient is still able to stand operation. Competent operative interference will reduce the mortality rate from one-half to one-fourth of the prevailing rate, attending the so-called conservative treatment. Surgical intervention should consist of attack on the bleeding point. Excision of the ulcer, hemostasis and careful closure of the mucosa in the least possible time consistent with good work is essential. Hemorrhage from an unlocalized lesion is not surgical.

Perforation.—Perforation occurs in over 25 per cent of ulcers, and accounts for 7 per cent of the deaths (Finney⁶). The treatment of perforation is immediate operation. The mortality in-

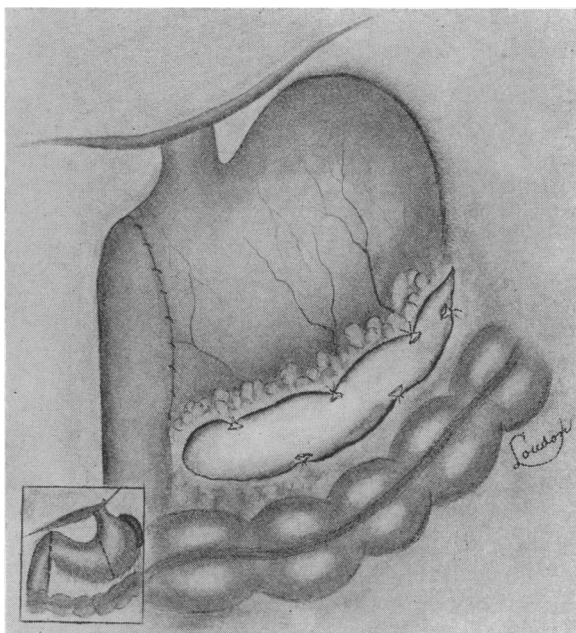


Fig. 3.—Gastro-duodenal anastomosis completed.

creases with each hour of delay. Perforated ulcer treated surgically within the twelve hours shows a mortality of about 10 per cent. When the operation is delayed the second twelve hours, the mortality becomes double or more. After twenty-four hours' time has elapsed nine out of each ten have lost their chance of recovery. The administration of opiates before a positive diagnosis has been made is usually responsible for the delay in operation.

Where there is a history of preëxisting ulcer, and the patient is seized with sudden pain, shock, abdominal rigidity along with typical blood changes, the diagnosis is easy. In atypical cases, without ulcer history and with comparatively mild symptoms, the condition may be overlooked. The administration of morphin before diagnosis is made becomes the patient's death warrant. X-ray evidence of air in the subphrenic space becomes a positive symptom when found, but its absence should not even delay operation when the other symptoms of perforation are positive. Operation consists of closure of the perforation and drainage. Excision of the ulcer may facilitate closure; a longitudinal incision and a transverse closure when the perforation is near the pylorus relieves obstruction. Closure of the perforation should be followed by a removal of the extruded stomach contents. Drainage should be inserted to the bottom of the pelvis and brought out through a suprapubic stab wound. Accumulations to the outer side of the cecum should be removed and drained by a separate stab wound made to the mesial side of the iliac spine when necessary.

Ulcus Carcinomatosis.—Signs of malignant changes call for a wide resection of the ulcer together with a removal of all tributary glands. Attachments to the pancreas are removed by the cautery, and drainage is inserted to the damaged pancreatic tissue. Restoration of the gastrointestinal tract depends on the amount of tissue

removed. The end of the stomach to the side of the duodenum is the method of choice. Where these structures cannot be approximated, the restoration may be effected by the so-called Polya or by a Bilroth II. With multiple ulcers near the cardia, a complete gastrectomy is indicated where there is a fair chance of success. Gastro-enterostomy is used only as a palliative operation.

Many apparently hopeless cases have passed the two-, three- and five-year periods without recurrences. The patient should be given an opportunity to recover by radical surgery even though the chances seem to be small.

IN CONCLUSION

Removal of persistent pathology and restoration of the normal sequence of the gastro-intestinal tract is the aim of surgery. Surgical relief of ulcer should not be undertaken by the casual operator. The mortality rate follows too closely the ability of the surgeon to permit of uncertainty. The average surgeon will not attempt the removal of a cataract, yet failure would result only in the loss of an eye. Lack of skill or of judgment in stomach surgery results in the patient's death. The field of stomach surgery has great possibilities. Regard for the lives of patients and for the reputation of the profession demand care and efficiency in this work.

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DISCUSSION

VERNE C. HUNT, M. D. (727 West Seventh Street, Los Angeles).—It is well known that malignant degeneration of a duodenal ulcer practically never occurs, and that primary malignancy at the site of a previously existing duodenal ulcer seldom, if ever, occurs; and, furthermore, that excision of a duodenal ulcer is not necessary in the course of a surgical procedure to produce a satisfactory result, in terms of permanent relief of all symptoms. Because a small percentage of chronic gastric ulcers undergo malignant degeneration, and because in a larger percentage of cases it is difficult and often impossible clinically to differentiate a benign gastric ulcer from an early primary carcinoma, or from a carcinomatous ulcer of the stomach, it is essential, in the surgical treatment of a gastric lesion, to excise the lesion as part of the surgical procedure. Little difference of opinion exists regarding this principle. Excision of most gastric ulcers may be accomplished by either relatively conservative methods or by radical partial gastrectomy. Not all gastric ulcers are amenable to surgical excision. In a recent review of 131 cases of gastric ulcer that I have operated upon, it was found that in 14 per cent of the cases the lesion was situ-

ated in the relatively inaccessible cardiac third of the stomach, either on the posterior wall or at the lesser curvature; in which instances excision was not readily instituted. There were others in which their high situation, or where protective perforation of a large ulcer posteriorly made excision inadvisable. In 20 per cent of the cases of gastric ulcer, excision of the lesion, for one reason or another, was not carried out, but instead the indirect operation of posterior gastro-enterostomy was employed. In the remainder of the cases the relatively conservative surgical procedure of local excision of the ulcer and posterior gastro-enterostomy was employed in 71 per cent of the cases, and partial gastrectomy in 29 per cent of the cases. The selection of the surgical procedure best suited to the individual case is based largely on the size and location of the lesion. Experience has adequately proved that the operation of local excision of a small benign gastric ulcer in the pyloric or middle third of the stomach and posterior gastro-enterostomy has been productive of excellent results, with few recurrences of a gastric ulcer and few instances of recurrent ulcer at or about the gastro-enterostomy stoma. In the cases of large gastric ulcer in an accessible portion of the stomach, and particularly such lesions in which, upon inspection and palpation, it is impossible to dismiss the question of a malignant lesion and in which gastric resection may be carried out, partial gastrectomy is the operation of choice. The method of establishing gastro-intestinal continuity following partial gastrectomy, whether by the Billroth No. 1 procedure, the gastrojejunal end-to-side method of Polya, or the gastroduodenal end-to-side anastomosis as described by Doctor Phillips, is dependent upon many factors, and the surgeon will usually select the method best suited in his hands to the situation as he finds it. There is much on a physiologic basis to urge the utilization of end-to-side gastroduodenal anastomosis, as described by Doctor Phillips as the method of choice in restoring gastro-intestinal continuity after partial gastrectomy when it may be accomplished readily. It is noteworthy, however, that sufficient mobilization of the duodenum is not always readily accomplished to facilitate such an anastomosis with maximum assurance of satisfactory post-operative function. Doctor Phillips has brought to your attention a method of establishing gastro-intestinal continuity after partial gastrectomy, which is applicable in certain cases, and physiologically fulfills certain prerequisites to the elimination of new anastomotic ulcers, which are not fulfilled entirely by the usual methods of reestablishing gastro-intestinal continuity.

I should like to ask the question, "What has been the mortality rate of this particular procedure in the surgical treatment of gastric ulcer?" While the operation of partial gastrectomy is the operation of choice or necessity in certain gastric ulcers, the relatively low mortality rate and the excellent results of the conservative surgical procedure of local excision of a gastric ulcer and posterior gastro-enterostomy should not be forgotten.

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ASA WESTON COLLINS, M. D. (450 Sutter Street, San Francisco).—My experience in partial removal of the stomach and gastro-enterostomy consists of over 200 cases, practically all directed toward the relief of pyloric and duodenal ulcer.

In an article published in *CALIFORNIA AND WESTERN MEDICINE* in September, 1931, I reported ninety-four cases, with a mortality of 5.25 per cent. All of these cases were operated by a method of my own, which is a modification of the Doyen operation. There are four points to be observed in all operations: No leakage, no hemorrhage, rapid technique, and no tension of any of the structures. There are two chief functions of the gastro-intestinal tract: First, digestion and second, motility. If anything interferes with the free movement of peristalsis, trouble starts.

Faulty technique is the cause of failure in practically all operations in this field. If the technique is perfect, all should survive. Shock is overcome by rapidity of operating, and the manual dexterity of the operator insures against hemorrhage and leakage. Plastic work on the stomach or intestine is meticulous, and I quite agree with Doctor Phillips that this type of surgery should be con-

finer to a few well-qualified surgeons. I do not believe that there is any one standardized operation to be used in all cases. Silk and linen are nice to work with, but I never use them.

The point that Doctor Phillips wants to put over, as I take it, is the removal of as much of the pyloric end of the stomach as possible, to prevent postoperative jejunal ulcer from the acid of the stomach. This he has done very nicely, and I quite agree with him.

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GEORGE THOMASON, M.D. (606 South Hill Street, Los Angeles).—Perusal of Doctor Phillips' paper discloses much for approval and very little ground for difference of opinion.

Certain features of the paper will bear repetition, merely by way of emphasis; as, for instance, that the treatment of stomach ulcer in early life is certainly medical, as such a large majority of them have so strong a tendency to spontaneous healing if given a fair opportunity by means of a carefully regulated regimen, intelligently and faithfully carried out by the patient.

In harmony with the sentiments of the paper we cannot justify the all too radical procedure of extensive gastric resection for ulcer in younger patients, as so generally practiced by Continental surgeons, and by a few in this country as a routine practice. The simple procedure of excision of the ulcer and a pyloroplasty will be feasible in a majority of these cases, and the pyloroplasty will sufficiently modify the gastric function and secretion as to make any recurrence of the ulcer but a remote possibility.

Boldyreff of Battle Creek, Michigan, was evidently correct in his contention that the level of gastric acidity under normal circumstances is regulated by the neutralizing effect of the pancreatic juice, which gains access to the stomach by reflux through the pylorus. This feature was later confirmed by the researches of Olch and Elman. A pyloroplasty, by removing sphincteric action of the pylorus, certainly greatly facilitates this reflux of alkaline juices, thus lowering gastric acidity.

While most of the resections of the stomach do not actually remove the acid-producing glands—these being largely located in the cardia—the resection does take away the area in which the reflex stimulation of the peptic glands originates, and produces, according to Lewisoohn, at least a hypochlorhydria in more than 80 per cent of cases. In cases in which conditions are present, so as to make pyloroplasty impractical, certainly resection should be done in preference to an excision of the ulcer and gastro-enterostomy. In older patients, because of the increased danger of malignancy complicating the ulcer, and in younger individuals where less heroic measures cannot safely be utilized, resection is obviously the procedure of choice.

Doctor Phillips states: "The indications for operation vary with the ability of the operator." While this unfortunately is true, it is to be deplored, and the ideal procedure could be carried out if only experienced and wholly qualified surgeons would undertake this testing type of surgery.

The type of operation which Doctor Phillips outlines, the modified Billroth No. 1, by preserving the continuity of the normal gastro-intestinal tract in reestablishing the connection between the stomach and duodenum, is undoubtedly the most desirable when possible to perform. It is surprising at times the amount of stomach which can be removed and still have the cut edge of the stomach brought over to the duodenum. When this is done, we believe it is desirable to tack the stomach to the round ligament of the liver with a few interrupted sutures, which will greatly relieve the tension upon the suture line.

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DOCTOR PHILLIPS (Closing).—Doctor Hunt has included duodenal ulcer in the scope of this discussion of the treatment of stomach ulcer. I believe it really belongs there. Granted, duodenal ulcer rarely, if ever, becomes malignant; yet the fact that it frequently does not heal, bleeds and sometimes perforates, following surgery which does not remove it, is sufficient reason for its removal when it can be performed without undue risk to the patient.

In operating on gastrojejunal ulcers, I have found the duodenal ulcers still active in several cases. The longest period of activity of a duodenal ulcer, following a gastro-enterostomy, noted in my work, was one of over fifteen years with serious exsanguination occurring several times during that period. These findings have convinced me of the necessity of removing ulcers of the duodenum, consistent with the safety of the patient. We have also encountered perforations of duodenal ulcers following functioning gastro-enterostomies.

Doctor Hunt has pointed out the impossibility, in all cases, of clinically determining the malignancy of stomach ulceration. Safety demands the wide excision of all ulcers and the adjacent glands such as can only be accomplished by gastric resection.

The operation I have described permits the wide removal, with comparative ease, of the distal half of the stomach, the adjacent glands, and first portion of the duodenum. Ulcers of the fundus of the stomach show such a high percentage of malignancy as to require their radical removal routinely.

I have found that about 80 per cent of the cases of stomach ulcers can be readily removed by the resection and duodenal anastomosis described. The remainder should be resected, and the continuity of the gastro-intestinal tract be restored by the methods of Polya or Billroth, or by total gastrectomy. Local excision is not sufficient where malignancy may exist.

There has been no mortality in uncomplicated cases since I have adopted this method. There has been no untoward results in these few cases (twenty). Convalescence has been shorter, and the gain in weight and strength has been much more rapid than in any other type of stomach operation. The results have been much superior to others in a previous series of two hundred cases of stomach ulcer treated by gastro-enterostomy and pyloroplasty.

The mobilization of the duodenum need not be carried on to any great extent. In cases of ulcer of the first portion of the duodenum, a moderate displacement of the duodenum is met with a wide displacement of the stomach to the right.

In the removal of gastrojejunal ulcers, following gastro-enterostomy, where the enterostomy was placed well to the left, it was necessary to resect not only the enterostomy opening but also the duodenal ulcers, which were still active. The results were a fundus lying in the midline, and the line of anastomosis was to the right. The results in these cases were the same: the patients noticed hunger a little sooner, and the added food caused a little more rapid gain in weight. Comparing the results of gastro-enterostomy, pyloroplasty and resection, I am convinced that in suitable cases resection offers the greatest chance for complete recovery.

The dangers of resection in competent hands are not larger than in gastro-enterostomy or pyloroplasty. Doctor Collins made a statement which I wish to emphasize: "Faulty technique is the cause of failure in practically all operations in this field." I would substitute "mortality" for "failure." The aim of the operation is not only to prevent jejunal ulceration from lowering the acidity of the stomach, but, more important, it furnishes an opportunity to remove a large majority of the ulcers and ulcer-bearing area in the stomach, and at the same time reestablish the continuity of the gastro-intestinal tract so that subsequent ulceration will be almost unknown.

Doctor Thomason has brought up the question of reduction of the acidity of the stomach following the removal of the pyloric sphincter by the influx of the duodenal secretions into the stomach.

Dr. Emmet Rixford brought out the theory of gastric secretion, that our progenitors gulped large chunks of food, which were unable to pass the pylorus. Nature remedied this by an outpouring of additional gastric secretion digesting the pieces so they could pass the pyloric sphincter. This inheritance possibly explains the hypersecretions in duodenal contraction. Hyperacidity depends on the reflex set up by the presence of food trying to pass the pylorus. Section of the pyloric end of the stomach destroys the reflex arc responsible for the excess acid secretion. The radical reduction of acidity removes the chief cause of

ulceration, and removing the part of the stomach most liable to ulceration reduces the incidence of ulcer to a minimum.

In conclusion, I wish to emphasize that the field of stomach surgery should be restricted to those adept and thoroughly trained. The average doctor may not attempt many operations where there is little danger to the patient's life, but he will sometimes attempt to remove stomach ulcers when lack of efficiency means death to the patient. Lack of skill is responsible for 90 per cent of the accidents of gastric surgery.

I deeply appreciate the discussion of Doctors Hunt, Collins, Rixford, and Thomason; they have added much to this brief presentation.

OSTEOMYELITIS AND SUPPURATIVE JOINTS: SALT WATER POOL TREATMENT*

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DISCUSSION by Francis M. McKeever, M.D., Los Angeles; Frederic C. Bost, M.D., San Francisco; Samuel S. Mathews, M.D., Los Angeles.

THESE two conditions, osteomyelitis and suppurative arthritis, are presented together as one subject because they are closely allied clinically, and are also often associated together as part of the same infection process. However, from the standpoint of treatment, they should be considered as separate clinical entities because, as will be shown later, the fundamental principles underlying their treatment are distinctly different.

Most of the various antiseptic formulae that have been developed have been tried in the treatment of osteomyelitis, but the ideal antiseptic that will destroy bacteria in the living body without harming the tissues has not been found. In osteomyelitis, particularly, such form of treatment is futile, because the solution cannot possibly reach the microscopic limits of the infection.

With the advent of bacteriophage treatment, the medical profession had high hopes that here at last was a form of therapy that would have a direct and beneficial therapeutic effect in osteomyelitis. From a theoretical standpoint this would seem the ideal way to deal with any type of infection; but, in spite of all the theoretical implications, the fact remains that the stubborn course of bone infection has not been greatly altered.

I think the same may be said of maggot therapy. There is no doubt that good results have been obtained with this mode of treatment, and the same may be said of other forms of treatment in use. Many cases of osteomyelitis, either because of the low virulence of the organism or the high resistance of the host, tend to be a self-limiting disease and eventually get well. However, acute bone infections remain one of the most intractable conditions that the surgeon is called upon to treat.

The fundamental principles underlying the treatment of infection have been known and practiced for a long time. These two cardinal principles—adequate drainage and rest—are as true and impor-

* From the clinics of the Orthopedic Hospital, Los Angeles.

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TABLE 1.—*Acute Suppurative Arthritis*

Eight Cases Incision and Drainage Followed by Salt Pool Treatment	
Joint involved	{ Knee 5 cases Hip 2 cases Ankle 1 case
Sex	{ Male 6 Female 2
Average age	6½ years
Invading organism	{ Negative culture 2 Streptococcus 4 Staphylococcus aureus 2
Time required for wound to heal	2.8 months
Return of motion	Complete
Time required to obtain motion	5 months

tant today as they were in the earliest days of surgery.

The practical application of these principles in the treatment of osteomyelitis is best exemplified in the Winnett Orr treatment. When meticulously carried out, this method not only satisfies the two prime tenets of adequate drainage and rest, both local to the diseased part and general rest of the patient, but it also prevents contamination from frequent dressings. I think it may be said without much fear of contradiction that the Orr treatment has given on the whole to surgeons over the country a degree of success that has not been approached by any other form of treatment.

In spite of the above statement, I believe that this treatment has definite shortcomings in certain types of cases. When the infective process is in close proximity to the major joints, especially when located at the distal end of the femur or near the elbow joint, and more particularly if there is an accompanying suppurative arthritis of the neighboring joint, then one of our main problems in treating this patient is to preserve for him as much joint motion as possible. Restoration of motion in a pus-ridden joint is not best accomplished by a long period of immobilization in plaster casts.

It is in support of this contention that the salt water pool treatment of bone and joint infections is here described. While we have used this treatment in over a hundred cases of osteomyelitis, this paper is concerned only with suppurative arthritis and osteomyelitis in which adjacent joints are also involved, or when the diseased process closely encroaches upon joint structures. It is in these particular types of cases, in which preservation of joint motion is one of the vital issues, that the salt-pool treatment has its greatest field of usefulness.

ACUTE SUPPURATIVE ARTHRITIS

It was first shown by Willems during the World War, and it has been thoroughly substantiated since, that regeneration of pus-ridden joints and restoration of function are best accomplished by early evacuation and motion.

Motion of an infected joint should not create muscle spasm. It should be painless and free of the fear of pain, and there should be no discomfort